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ECOLOGICAL STUDIES ON THE SOIL AND VEGETATION OF KRUSADI GROUP OF ISLANDS IN THE GULF OF MANAAR

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ABSTRACT

The account presents the plant ecology with a description of soils and other related features of the Krusadi group of islands situated in the Gulf of Manaar approximately between 9°14′-9°15′N and 79°10.5′-79°14.5′ E. Data on pH, organic matter contents, total soluble salts, sodium chloride contents and calcium carbonate contents in the soils of different habitats are presented in tabular form and an attempt made to correlate vegetation with the soil features. A classification of vegetation situations rather than strictly vegetation types has been brought out and comparison made with the main neighbouring island of Rameswaram with similar climate. The paper includes a vegetation map of the area prepared during the field work.

INTRODUCTION

Recently the ecology of Rameswaram Island with special reference to sand dune flora and habitat has been worked out (Rao et al, 1963). The present account is an extension of such studies to the Krusadi group of islands. The main object of the work is to classify vegetation based upon plants and habitats and thus to bring forward a classification of vegetation situations rather than strictly vegetation types and to see how far the vegetation differs materially from that of the adjacent main island.

Krusadi group of islands is situated in the Gulf of Manaar approximately 9°14′-9°15′ N and 79°10.5′-79°14.5′ E. It consists of five islands namely Pumurichan (Pulle) Island, Wadu Island, Periya kanda Island, Krusadi Island and Shingle Island, the former four are separated from one another by very short distances in shallow waters and during low tide appear as if there is a single island. The Shingle Island to the east of Krusadi Island is about 2.5 km. away from the latter. Collectively the length of the former four islands is approximately 5.4 km.; width at the broadest part being about 0.4 km. Shingle Island is a small island comparatively. This group of islands lies in the south of the western end of Rameswaram Island and the eastern end of the mainland of Ramnad District. These islands are approachable from Pamban by a boat or launch either from the southern side of the Pamban Bridge or by a boat from the western edge of Rameswaram Island called Kuthikal point.

CLIMATE

The climate of these islands is very similar to that of Rameswaram Island. The temperature and humidity remain quite high throughout the year. The average annual rainfall is about 40 inches (1016 mm.). More characteristic, however, than the amount of rainfall is its distribution throughout the year; 25-30 inches (635-762 mm.) of rainfall is recorded during the months of November and December generally, as these islands get the benefit of North East Monsoon. Due to the South West Monsoon there are only a few showers and there is a long dry spell during the summer season.

SOILS & OTHER RELATED IMPORTANT FEATURES

The coastal line consists of raised coral reefs and shells of the marine microfauna and mollusca. Soils composed of the shells of the microfauna and mollusca lie loose on the coast and mantles of similar soil extend inland forming covers of various thicknesses over the underlying stratum. These soils contain small proportions of quartz, felspar and heavy mineral particles *viz.* magnetite, garnet and ilmenite transported by wind and wave action from other regions. These islands necessarily seem to be coralline. Genetically the soils are the same throughout the area of these islands. However, different habitats can be distinguished on the basis of levels of salinity and organic matter etc. in the soils and their physical characteristics, i.e. whether they are inundated by sea water or fresh water, are muddy or marshy or loose sandy and the corresponding plant communities prevalent there.

The water table is very high and it does not sink to more than 1 metre below the surface in most part of these islands even in the summer and most dry months. Water is brackish and under the influence of sea water. Boring trials have failed to tap fresh water anywhere in these islands. During the high tide low lying areas are inundated by sea water. White incrustations of salts were visible in such areas, especially the salt marsh at the time of collection of soil samples in the dry month of September.

VEGETATION

This group of islands is not widely separated from that of the nearest mainland and the other bigger island namely Rameswaram. The recent studies by the writers on the Rameswaram Island have revealed that the vegetation falls in the category of the Dry

Tropical Thorn Umbrella type degraded to low open scrub formation due to severe biotic and climatic causes. As a contrast to this type of vegetation, the vegetation of these islands cannot be classified under a single distinctive type of vegetation. Mainly they can be grouped under mangrove and strand formations. Based upon their edaphic features, they are further classified into distinct units.

METHODS

With a view to study the soil characteristics and their correlation with the vegetation in the different habitats, soil samples were collected and analysed in the laboratory for pH, organic matter content, soluble salts contents, sodium chloride and calcium carbonate contents by the usual standard methods. As the soil samples were collected during the dry spell, it is likely that the salinity figures approach the maximum that should be found during the year. Frequent visits were paid to collect field data on the features of vegetation situations during different seasons of the year. A systematic list of the vascular flora is given at the end of the paper.

KRUSADI ISLAND

In the Krusadi Island, which is about 2.5 km. long and about 0.4 km. at its broadest part, five different habitats can be distinguished on soil-vegetation basis:

1. Foreshore sandy habitat
2. Inland sandy habitat
3. Salt marsh habitat
4. Mangrove habitat
5. Maritime habitat

1. Foreshore Sandy Habitat

This habitat stretches along the entire southern shore and partly along the eastern wing of the northern shore. The soils are loose and light coarse sandy, coloured dull white and mostly consisting of shell fragments and disintegrated coral rocks ($CaCO_3$ 74.74-87.03%; Table Ia). The soil profile representing sample Nos. 201-204 will indicate that practically there is no change in the $CaCO_3$ content of the soil downwards. As the situation of the profile was comparatively on a raised level, no water was met up to a depth of at least 1 metre. Soil upto a depth of 25 cm. was almost dry, after which it became moist and moisture increased with depth. The soil is immature and there is no development of horizons. The pH values of more than 8.2 of the soil samples indicate moderate alkalinity. Organic matter varies between 0.389-0.255% from top to bottom in the profile. Soluble salts and chloride contents of the samples are comparatively lower than those in other parts of the island and they increase from 0.084 to 0.242 and 0.020 to 0.104 respectively from top to bottom. It seems that the salts from sea spray have been leached downwards by fresh water.

The pH of the other samples from this habitat is similar to the samples from the profile. Organic matter contents (0.501% and 0.476%) are somewhat higher but the status of total soluble salts and sodium chloride contents remains unchanged more or less.

The dominating growth forms are the strand creepers, especially the beach morning glory *Ipomoea pes-caprae* occasionally touching the low shore line. This mat forming herb is an excellent sand binder and grows luxuriantly in pockets of moist areas. Sometimes the pure stand is intercepted either by *Atriplex repens* or by fleshy *Sesuvium portulacastrum.* Sandy mounds are invariably colonised by *Spinifex littoreus,* which is an excellent sand binder and adapted to strand life. Sandy depressions or sandy plains exhibit stands of *Cyperus pachyrrhizus* and *Halopyrum mucronatum* extending considerably from east to west on the southern shore. The only bushy shrub of this region is *Scaevola plumieri.*

2. Inland Sandy Habitat

This habitat occupies the bulk of the main area of the island. Mantles of sand similar to that met with on the foreshore have extended inward forming a cover of varying thicknesses over the underlying stratum. There is therefore practically no difference between the soils of foreshore sandy habitat and inland sandy habitat. But because of its better disposition and being better protected than the foreshore, it supports better vegetation.

Reference to Table IB will show that the pH of soil sample is more than 8.2. Organic matter (0.809%) is more than that in the foreshore soil samples, as can be expected due to the better vegetation cover here. Total soluble salts (0.261%) and sodium chloride content (0.203%) are also on the higher side comparatively than in the foreshore samples. This may be due to the lower level of the habitat in comparison to the foreshore and influence of sea water seepage to that level.

An analysis of the vegetation pattern reveals that on the northern side the non-littoral tree-sized *Thespesia populnea,* closely followed by *Borassus flabellifer* dominate whereas on the southern shore *Calotropis gigantea* and *Pandanus tectorius* form a distinctive marginal association. Intercepted among these dominant stands are *Azima tetracantha, Securinega leucopyrus, Breynia rhamnoides, Tarrenia asiatica* and *Clerodendron inerme.* These mixed associations extend even to the interior but at no time do they form a pure stand. In the interior they are gradually replaced by *Cymbopogon caesius, Indigofera oblongifolia* and scattered bushes of *Dodonaea viscosa.* Other interesting features are the occurrence of *Salvadora persica* stand of stunted tree-size and *Cassytha filiformis* parasitising almost all strand vegetation.

3. Salt Marsh Habitat

A little to the east of the midpoint on the northern side of the island, the shore recedes into a salt marsh, surrounded on its southern and eastern sides by small sand dunes. The salt marsh becomes temporarily inundated by sea water during high tides and on drying presents a white incrustation of salts on the soft moist soil below as could be seen at the time of collecting soil samples. After a depth of a few centimetres the soil became very moist and water was met at a depth of about 20 cm. only.

The soil samples of highly calcareous sand (63.13-63.15% $CaCO_3$) are dull white to dull white with pinkish tinge in colour. They are very pervious in nature but very moist due to high water table and poor drainage coupled with preservation of moisture by the salt crust formed on the surface of the underlying soils. The pH values of 8.2 and more are towards moderate alkalinity not much affected by the organic matter contents (0.542 and 0.404%). Total soluble salts (1.788 and 2.719%) and sodium chloride contents (1.383 and 2.274%) are very high and only plant communities and associations highly tolerant of salts are expected to thrive in this habitat.

This Halophytic zone is composed of *Suaeda* spp. closely followed by *Arthocnemum* spp. Next in importance are *Atriplex repens* and *Salicornia brachiata* forming a dense patch almost to the exclusion of any other plant. The mat forming Gramineae is represented by *Sporobolus tremulus* and *Aeluropus lagopoides* and along the edges one could see *Apluda mutica, Eremopogon foveolatus* and *Paspalum vaginatum* growing in abundance. Among the several sedges *Fimbristylis spathacea* forms a dense mat especially near depressions holding rain or saline water. Often one can see a few pure stands of *Avicennia officinalis* with its spreading root system and pneumatophores. *Salicornia-Arthocnemum* habitat is indicative of highest percentage of salts in the soil.

4. Mangrove Habitat

The western part of the northern shore is subjected to shallow water inundation for most part of the year and supports a thick growth of mangrove forest. Winds may be very strong on occasions, but even on the stormy days there is shelter in the mangrove and the water is not stirred into waves. Consequently the wave action is almost minimal. The surface material in this habitat possesses a pseudo-crumb structure, the result of the activity of living organisms such as fiddler crabs. The bluish-grey semi-muddy sand is cohesive enough to form permanent burrows for the crabs that inhabit the area.

The soil is semi-muddy coral sand ($CaCO_3$ 63.93%) with some cohesion (Table Id). It contains many hardy roots and some decomposing foliage. The pH (7.8) of the soil indicates mild alkalinity and contains fairly high organic matter content (1.737%) which probably has played its part in lowering the pH value. The high organic matter content is due to the thick cover of vegetation and the presence of innumerable crabs in the soil. Soluble salts (1.640%) and sodium chloride content (1.397%) although high because of the saturation of soil with sea water are comparatively lower than in the soils of the salt-marsh habitat.

The mangroves are chiefly represented by *Avicennia officinalis* almost forming a pure stand and occasionally interrupted by *Ceriops tagal, Rhizophora mucronata,* and *Bruguiera conjugata* all along the muddy flat. On such occasions when the muddy shore is replaced by coral stone, one could see the invasion and growth of *Pemphis acidula* adjacent to the mangrove zone. It is a good indicator of coral rock, often very rough. With less of mangrove habitat and infiltration of sandy habitat the interesting plants are *Lumnitzera racemosa* and *Excoecaria agallocha* which can tolerate a slightly firmer and drier soil than mangrove species.

5. Maritime Habitat

The shallow parts of the sea on the southern side are often exposed during low tide. This part abounds in numerous algae and a few phanerogams. This area continuing a little further north from Krusadi Island, leads into the Pamban Channel.

The soil here on exposure presents a muddy appearance. Pseudo-crumb structure is also visible quite often on the surface. It is composed of coral sand (68.81% $CaCO_3$, Table Ie). The sandy soil with some decomposed and decomposing organic matter from the vegetation and animals present there is fairly cohesive and bluish grey in colour. The pH (7.8) of the soil is the same as for soil of the mangrove habitat but the organic matter (1.049%) is comparatively lower. Soluble salt content (1.744%) and sodium chloride (1.284%) are more or less the same as in the soil of the mangrove habitat but comparatively lower than in the soils of the salt-marsh habitat.

The shallow Pamban Channel shelters an extensive patch of *Enhalus acoroides* and *Cymodoceas* and partially exposed coral rocks support *Halophila* spp.

PUMURICHAN (PULLE) ISLAND

Pumurichan island is situated to the extreme left of the Krusadi group of islands. The soil here is similar to that of the Krusadi island for calcium carbonate content. Based on vegetation situations two habitats can be distinguished in this island:

(1) Peripheral habitat.

(2) Central habitat.

(1) Peripheral Habitat

This portion of the island is often inundated with sea water during tide and presents a little muddy appearance when water recedes. The soil sample from this habitat, dull white in colour and with pH of more than 8.2, is very highly calcareous (calcium carbonate 70.21%). It contains 1.046% of organic matter. Total soluble salts (1.026%) and sodium chloride (0.748%) are quite high as a result of inundation with sea water (Table II).

This habitat supports a pure association of *Pemphis acidula* intercepted at certain locations by pure stands of *Rhizophora* or *Avicennia*. *Pemphis* is found growing in rocky substratum covered over by a mantle of sand and *Rhizophora* or *Avicennia* in muddy locations. Just on the inside of the peripheral habitat one could see isolated growth of *Thespesia populnea, Cordia semicordata, Caesalpinia crista* and *Casuarina.* In sandy or marshy locations the vegetal cover is made up of a mixed population of *Cyperus pachyrrhizus, Paspalum vaginatum, Trachys muricata, Aeluropus lagopoides, Agyneia bacciformis* and *Phyllanthus maderaspatensis.*

(2) Central Habitat

The central habitat is more or less a loose sandy habitat and almost free from inundation with sea water. A reference to Table II will show that the soil of this habitat is dull white in colour with pH value of more than 8.2 and highly calcareous (68.14% $CaCO_3$) in nature. Organic matter (0.635%) in this sample is lower comparatively than that in the sample from the periphery. Total soluble salts (0.028%) and sodium chloride (0.005%) are quite low.

This habitat supports grasses like *Cymbopogon caesius, Sporobolus spicatus, Eragrostis riparia* and *E. plumosa* but in some locations the vegetation is chiefly composed of *Dodonaea viscosa, Cassia auriculata* and *Dichrostachys cinerea.* Another wide spread plant is *Cassytha filiformis* found in abundance all ove the island.

WADU AND PERIYAKANDA ISLANDS

The vegetation situations and soil features in Wadu and Periyakanda islands are similar to that of Pulle island. The significant vegetation is that of *Pemphis acidula* closely followed by *Excoecaria agallocha, Caesalpinia crista* and other related strand types.

SHINGLE ISLAND

Shingle island about 2.5 km. away to the east of Krusadi island is a small island. Soil genesis of this island is also the same as that of Krusadi and Pulle islands. Three different habitats in the island may be distinguished on the basis of salinity levels and organic matter etc. in the soils and their disposition in relation to one another and the corresponding differences in vegetation situations:

(1) Foreshore coral limestone habitat or coral sand habitat
(2) Inland sandy flat habitat
(3) Inland creek habitat

Soil features and vegetation of each of the habitat in the island is described below and analytical data of soils presented in Table III.

(1) Foreshore Coral Limestone Habitat or Coral Sand Habitat

Soil sample from the foreshore coral limestone habitat contains 60.36% $CaCO_3$. Status of pH (more than 8.2), organic matter (1.187%), total soluble salts (0.924%) and sodium chloride (0.603%) is almost the same as for the soil collected from the periphery of Pulle island. The dominating vegetation of this habitat is *Pemphis acidula.*

The foreshore coral sand habitat is formed of loose coarse sandy soil composed mainly of coral pieces ($CaCO_3$ 64.78%). The pH of the sample collected is more than 8.2. Low organic matter (0.347%) is due to the scanty vegetation. Total soluble salts (0.078%) and sodium chloride (0.018%) are also low indicating sea spray only but no inundation with sea water or rise of sea water by capillary action due to the raised level of the habitat. The vegetation cover is a mixed population of *Cyperus pachyrrhizus, Paspalum vaginatum* and *Trachys muricata.*

(2) Inland Sandy Flat Habitat

The soils of the sandy flat habitat coloured dull white with pinkish tinge contain 72.93-76.79% $CaCO_3$. Values for pH vary between 7.6-8.2 and more. Organic matter varies between 0.506-1.300%. Total dissolved salts (0.060-0.075%) and sodium chloride (0.015-0.017) contents are practically constant.

In this area where the location happens to be sandy one could see mixed population of *Cyperus pachyrrhizus, Launaea sarmentosa* and *Halopyrum mucronatum* ; however, if the location happens to be coral heaps or coralline the commonly seen plants are *Pemphis acidula, Suriana maritima,* closely followed by *Excoecaria agallocha* and *Lumnitzera racemosa.*

(3) Inland Creek Habitat

The soil sample from the inland creek somewhat muddy with pH value of more than 8.2 contains 70.59% $CaCO_3$. Organic matter content of the sample is 0.503 %. Soluble salts (0.177 %) and sodium chloride (0.120 %) indicate the soil to be under the influence of sea water.

The vegetation is mainly composed of *Avicennia* with innumerable pneumatophores intercepted by *Atriplex repens, Suaeda nodiflora* and *Salicornia brachiata.*

SPECIAL FEATURES OF VEGETATION SITUATIONS

The soils composed of the broken coral reefs and shells of the microfauna and mollusca are very rich in their calcium carbonate contents throughout the area of these islands and different from soils of the neighbouring main island of Rameswaram, which are quartz derived sands mainly. However, different habitats in the Krusadi and Shingle islands have been distinguished on the basis of levels of salinity and organic matter etc. in the soils and their physical characteristics i.e. whether they are inundated by sea water or fresh water, are muddy or marshy or loose sandy and the corresponding plant communities prevalent there, which give a characteristic physiognomy to the habitats.

The situations as available in these islands are congenial for Strand, Mangrove or both the formations. The strand vegetation, its further growth and succession into a mesophytic forest is checked due to prevailing dry climate, higher salinity in the interior as marked out by *Salicornia-Arthocnemum* and paucity of real mesophytic species. The interior of these islands varies in relation to the habitat. Either there is thorny scrub associations gradually reduced either to a grass land or such areas inundated with sea water supporting halophytes with a few stands of *Avicennia officinalis.*

Another interesting feature is the presence of Mangrove habitat along with calcium-rich rocky habitat; as a result of this one could see often *Pemphis acidula* being mixed with *Avicennia, Bruguiera, Rhizophora* and others. The situation in Shingle island is slightly different. Certain common plants of Krusadi like *Borassus, Pandanus* and *Coconut* are not present in the island. The island being primarily composed of coral limestones and its disintegrated products is a congenial habitat for *Pemphis acidula.* Towards the interior as the area becomes slightly elevated it becomes habitable to woody plants like *Lumnitzera* and *Excoecaria. Thespesia populnea* is represented only by a few bushes in the centre of the island and a look at its distribution clearly shows that the habitat is not so helpful as that of Krusadi island for its propagation and spread. Another feature is the presence of *Scaevola plumieri,* a prostrate plant indicating the dryness of the habitat.

Chandrasekharan et al (1946) surveying the phanerogamic vegetation of the island pointed out that 'the vegetation of the island is of special interest as it differs much from that of the mainland and the nearer bigger island Rameswaram.' This view point is untenable because the present study has revealed that in this group of islands there are 110 species spread over into 42 families whereas in the nearest bigger island of Rameswaram there are 170 species representing 55 families. Rameswaram and Krusadi group of islands have about 80 species in common whereas 31 species are exclusively found in the Krusadi group of islands. Undoubtedly the flora of this group of islands is bound up with that of Rameswaram island flora and the point of special interest is species like *Salvadora persica* of Salvadoraceae, *Scaevola frutescens* and *S. plumieri* of Goodeniaceae, *Polycarpaea spicata* and *P. corymbosa* of Caryophyllaceae, *Solanum trilobatum* of Solanaceae, *Asparagus gonocladus* of Liliaceae, *Halopyrum mucronatum* and *Trachys muricata* of Gramineae, which are exclusively confined to this group of islands not seen in the main island of Rameswaram. Similarly *Suriana maritima* and *Cordia subcordata* the strand plants of the coasts of Ceylon, Andaman, Laccadive and Nicobar islands have succeeded in establishing themselves in the Krusadi group of islands and not anywhere in the bigger Rameswaram island. Perhaps this may be due to the fact that though Rameswaram is the biggest island, true islandic condition is not existing there as can be seen in the Krusadi group of islands. No doubt there is a close affinity with the flora of Rameswaram island but the distribution pattern of plants is entirely dependent upon situations.

A Check List

A. Plants common to Rameswaram and Krusadi group of islands:

PORTULACACEAE :
Portulaca tuberosa Roxb.

MALVACEAE :
Sida cordifolia L.
Abutilon indicum Sw.
Hibiscus tiliaceus L.
Thespesia populnea Soland. ex Correa

ZYGOPHYLLACEAE :
Tribulus terrestris L.

BURSERACEAE :
Commiphora roxburghii (Stocks) Engler

MELIACEAE :
Azadirachta indica A. Juss.

VITACEAE :
Cissus quadrangularis L.

SAPINDACEAE :
Dodonaea viscosa L.

LEGUMINOSAE :
Phaseolus trilobus Ait.
Caesalpinia bonduc (L.) Roxb.
Cassia auriculata L.
Dichrostachys cinerea Wt. & Arn.
Acacia planifrons Wt. & Arn.

RHIZOPHORACEAE :
Ceriops tagal (Perr.) C. B. Robins
Bruguiera conjugata (L.) Merrill

COMBRETACEAE :
Lumnitzera racemosa Willd.

MYRTACEAE :
Syzygium cumini (L.) Skeels

LYTHRACEAE :
Pemphis acidula Forst.

- CUCURBITACEAE :
  - *Colocynthis vulgaris* Schr.
  - *Coccinia cordifolia* (L.) Cogn.
- AIZOACEAE :
  - *Sesuvium portulacastrum* L.
- RUBIACEAE :
  - *Tarenna asiatica* O. Kze.
- COMPOSITAE :
  - *Vernonia cinerea* Less.
  - *Blumea obliqua* (L.) Druce
  - *Vicoa indica* (Willd.) DC.
  - *Eclipta alba* Hassk.
  - *Lauraea sarmentosa* (Willd.) Alston
- SALVADORACEAE :
  - *Azima tetracantha* Lamk.
- APOCYNACEAE :
  - *Catharanthus roseus* (L.) G. Don.
- ASCLEPIADACEAE :
  - *Calotropis gigantea* R. Br.
  - *Pentatropis microphylla,* Wt. & Arn.
  - *Tylophora indica* (Burm. f.) Merr.
- GENTIANACEAE :
  - *Enicostema verticillatum* (L.) Engl.
- BORAGINACEAE :
  - *Heliotropium curassavicum* L.
- CONVOLVULACEAE :
  - *Ipomoea pes-caprae* Sweet
  - *Evolvulus alsinoides* L.
- SOLANACEAE :
  - *Physalis minima* L.
- ACANTHACEAE :
  - *Asystasia gangetica* T. And.
- VERBENACEAE :
  - *Phyla nodiflora* (L.) Greene
  - *Premna serratifolia* L.
  - *Clerodendron inerme* Gaertn.
  - *Vitex negundo* L.
  - *Avicennia officinalis* L.
- LABIATAE :
  - *Leucas aspera* Spreng.
  - *Anisomeles malabarica* R. Br.
- NYCTAGINACEAE :
  - *Boerhaavia diffusa* L.
- AMARANTACEAE :
  - *Aerva javanica* Juss.
  - *A. lanata* Juss.
- CHENOPODIACEAE :
  - *Arthrocnemum indicum* Moq.
  - *Salicornia brachiata* Roxb.
- LAURACEAE :
  - *Cassytha filiformis* L.
- EUPHORBIACEAE :
  - *Euphorbia hypericifolia* L.
  - *E. hirta* L.
  - *Agyneia bacciformis* A. Juss.
  - *Phyllanthus maderaspatensis* L.
  - *Securinega leucopyrus* (Willd.) Muell.-Arg.
  - *Breynia rhamnoides* Muell.-Arg.
  - *Excoecaria agallocha* L.
  - *Acalypha brachystachya* Hornem.
- CASUARINACEAE :
  - *Casuarina equisetifolia* Forst.
- HYDROCHARITACEAE :
  - *Halophila ovalis* Hook. f.
  - *Enhalus acoroides* Rich. ex Steud.
- LILIACEAE :
  - *Gloriosa superba* L.
- COMMELINACEAE :
  - *Cyanotis cristata* Schult. f.
- PALMACEAE :
  - *Cocos nucifera* L.
  - *Phoenix farinifera* Roxb.
  - *Borassus flabellifer* L.
- PANDANACEAE :
  - *Pandanus tectorius* Soland.
- POTAMOGETONACEAE :
  - *Ruppia maritima* L.
  - *Cymodocea rotundata* Asch. & Sch.
  - *C. serrulata* Asch. & Mag.
- CYPERACEAE :
  - *Cyperus arenarius* Retz.
  - *C. pachyrrhizus* Nees
  - *C. bulbosus* Vahl
  - *Bulbostylis barbata* Kunth
- GRAMINEAE :
  - *Paspalum vaginatum* Sw.
  - *Sporobolus maderaspatansus* Bor
  - *Spinifex littoreus* (Burm. f.) Merr.
  - *Apluda mutica* L.
  - *Aeluropus lagopoides* Trin.

B. Plants restricted to Krusadi group of islands:

- CARYOPHYLLACEAE :
  - *Polycarpaea spicata* W. & A.
  - *P. corymbosa* Lamk.
- SIMARUBACEAE :
  - *Suriana maritima* L.
- LEGUMINOSAE :
  - *Indigofera hirsuta* L.
  - *I. oblongifolia* Forsk.
  - *I. subulata* Vahl
- RUBIACEAE :
  - *Oldenlandia corymbosa* L.
  - *O. wightii* Hook. f.
  - *O. umbellata* L.
- COMPOSITAE :
  - *Vicoa indica* DC.
- GOODENIACEAE :
  - *Scaevola frutescens* Krause
  - *S. plumieri* Vahl
- SALVADORACEAE :
  - *Salvadora persica* L.
- BORAGINACEAE :
  - *Cordia subcordata* Lamk.
- CONVOLVULACEAE :
  - *Calonyction bona-nox* Boj.
- SOLANACEAE :
  - *Solanum trilobatum* L. f.

SCROPHULARIACEAE :
Striga euphrasioides Benth.
Sopubia delphinifolia G. Don
CHENOPODIACEAE :
Atriplex repens Roth
LILIACEAE :
Asparagus gonocladus Bak.
CYPERACEAE :
Fimbristylis spathacea Roth
F. tristachya Thw.
GRAMINEAE :
Cymbopogon caesius Stapf
Sporobolus tremulus (Willd.) Kunth
S. spicatus Kunth
S. virginious Kunth
Eragrostis riparia Nees
Eragrostis viscosa Trin.
E. plumosa Link.
Halopyrum mucronatum Stapf
Trachys muricata Steud.

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TABLE I

Analysis of soil samples collected within different habitats in the Krusadi Island

Soil sample No.	Profile No.	Location	Depth of sampling in cm.	Vegetation cover	Soil colour	pH	Organic matter %	Total soluble salts %	Sodium chloride %	Calcium carbonate %
201	1	Foreshore on the southern side	-1-0	(a) *Foreshore sandy habitat :—* *Scaevola frutescens*				litter		
202	,,		0.22.5		Dull white	More than 8.2	0.389	0.084	0,020	79.47
203	,,		22.5-42.5		-do-	-do-	0.237	0.138	0.069	87.03
204	,,		42.5-90		-do-	-do-	0.225	0.242	0.104	83.09
292	Nil	-do-	0-10	*Scaevola plumieri and Spinifex littoreus*	-do-	-do-	0.501	0.159	0.073	76.31
293	Nil	Foreshore on the eastern wing	0-10	*Sporobolus tremulus and Cyperus pachyrrhizus*	-do-	-do-	0.476	0.071	0.005	74.74
295	Nil	Central portion	0-10	(b) *Inland sandy habitat :—* *Thespesia populnea*	Dull white with pinkish tinge	-do-	0.809	0.361	0.203	65.73
207	Nil	Salt marsh	0-10	(c) *Salt marsh habitat :—* *Arthrocnemum indicum, and Salicornia brachiata*	Dull white	8.2	0.542	2.719	2.274	63.13
294	Nil	-do-	0-10	*Arthrocnemum indicum, Salicornia brachiata and Artiplex repens*	Dull white with pinkish tinge	More than 8.2	0.404	1.788	1.383	63.15
206	Nil	Western part of northern shore	0-10	(d) *Mangrove habitat :—* *Bruguiera cylindrica, Rhizophora mucronata and Pemphis acidula*	Bluish grey	7.8	1.737	1.640	1.397	63.93
205	Nil	Shallow sea on southern side	0-10	(e) *Maritime habitat :—* *Algae and Halophila ovalis, H. balfouri, Cymodoceae and Enhalus accroides*	Bluish grey	7.8	1.049	1.744	1.284	68.81

TABLE II

Analysis of soil samples collected within Pumurichan (Pulle) Island

Soil sample No.	Location	Depth of sampling in cm..	Vegetation cover	Soil colour	pH	Organic matter %	Total soluble salts %	Sodium chloride %	Calcium carbonate %
301	Peripheral habitat	0-10	*Pemphis acidula*	Dull white	More than 8.2	1.046	1.026	0.748	70.21
302	Central habitat	0-10	*Cymbopogon caesius, Sporobolus spicatus and Eragrostis riparia*	Dull white	-do-	0.635	0.028	0.005	68.14

TABLE III

Analysis of soil samples collected within Shingle Island

Soil sample No.	Location	Depth of sampling in cm.	Vegetation cover	Soil colour	pH	Organic matter %	Total soluble salts %	Sodium chloride %	Calcium carbonate %
296	Foreshore coral lime-stone habitat	0-10	*Pemphis acidula*	Very light grey	More than 8.2	1.187	0.924	0.603	60.36
297	Foreshore coral sand habitat	0-10	*Cyperus pachyrrhizus*	Dull white	-do-	0.347	0.078	0.018	64.78
299	Inland sandy flat habitat	0-10	*Halopyrum mucronatum, Launaea sarmentosa & Cyperus pachyrrhizus*	Dull white with pinkish tinge	-do-	0.506	0.060	0.017	76.79
300	-do-	0-10	*Pemphis acidula* and *Suriana maritima*	Dull white with pinkish tinge	7.8	1.300	0.075	0.015	72.93
298	Inland creek habitat	0-10	*Avicennia officinalis* and *Atriplex repens*	Dull white with pinkish tinge	More than 8.2	0.503	0.177	0.120	70.59

VEGETATION MAP OF KRUSADI ISLANDS